IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application No.:	09/941,371
Filing Date:	August 28, 2001
Inventor(s):	Mark Kintis
Group Art Unit:	2611
Examiner Name:	Nguyen, Leon Viet Q
Customer No.:	27160
Title:	Phase Modulation Power Spreading ...
Confirmation No.:	6016

Applicant's Brief On Appeal

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

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Real Party In Interest

The real party in interest is Northrop Grumman Systems Corporation by way of an assignment from Mark Kintis to TRW, Inc, recorded on Reel 012131/Frame 0003 and an assignment from TRW, Inc to Northrop Grumman Corporation, recorded on Reel 013751/Frame 0849 and an assignment from Northrop Grumman Corporation to Northrop Grumman Space & Mission Systems Corporation by way of an assignment recorded on Reel 023699/ Frame 0551 and an assignment from Northrop Grumman Space & Mission Systems Corporation to Northrop Grumman Systems Corporation, recorded on Reel 023915/Frame 0446.

Related Appeals and Interferences

There are no other appeals or interferences known to the Appellant or the Appellant's representative, which are believed to directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

Status Of Claims

Claims 1-6, 12-15 and 28-32 are pending. Claims 7-11 and 16-27 have been canceled. Claims 1-6, 12-15 and 28-32 stand rejected and are being appealed.

Status Of Amendments

No amendments have been filed subsequent to the Final Rejection.

Summary Of Claimed Subject Matter

The inventions recited in independent claims 1 and 28 relate to a mixer circuit for reducing the power level of spurious input signals ("spurs"). Mixers are used for used for up-converting or down-converting the frequency of an input signal. In general, known mixers include two (2) input ports and an output port. The input signal is applied to one input port and a local oscillator signal is applied to the other input port. The output signal appears at the output port and is either up-converted or down-converted depending on the frequency of the local oscillator relative to the frequency of the input signal As discussed in paragraphs [0003] and [0004] of the specification, an inherent characteristic of such mixers for mixing signals of different frequencies is that spurs are produced at the output port along with the desired output frequency. These spurs are produced at different power levels The spurs are undesirable especially spurs at relatively high levels. As such, the spurs are known to be filtered out. The filters add to the cost of the system and can be relatively expensive in certain applications as discussed in paragraph [0009] of the specification.

As discussed in paragraphs [0016] and [0017] of the specification, the mixer circuits recited in independent claims 1 and 28 eliminate the need for relatively expensive filters for filtering out of band spurs. i.e. undesirable spurs, that are normally concentrated at single frequencies requiring relatively expensive third and fourth order filters. Rather the spurs are spread over a relatively wide bandwidth, thereby reducing the power in narrow bandwidth windows.

In general, the apparatus and method recited in independent claims 1 and 28 relates to a system and method to reduce output power spurs resulting from mixing a an input RF or microwave signal having a frequency f_1 with a local oscillator (LO) signal having a frequency f_2 to change the frequency of the input signal. For example, as discussed in the specification and is well known in the art, when a mixer is used as an up-converter, the output of the mixer is $f_1 + f_2$. Similarly , when a mixer is used as a down-converter, the output of the mixer is $f_1 - f_2$ or $f_2 - f_1$. Unfortunately, the mixers also generate unwanted spurious output signals at different frequencies , normally called spurs, in addition to the up-converted or down-converted signals. The spurs are normally filtered out by filters. In some instances, some of the spurs are difficult if not impossible to filter out.

More specifically, is illustrated in Fig. 3 below. The inventions recited in independent claims 1 and 28 include two mixers 44 and 46. Each mixer 44,46 includes two (2) input ports and an output port. In addition to the mixers 44 and 46 each mixer stage also includes a phase modulator 50 and 52, respectively. The phase modulators 50 and 52 are used to phase modulate the local oscillator signals L01 and L02 fed into one of the inputs of the mixers 44 and 46 , respectively.

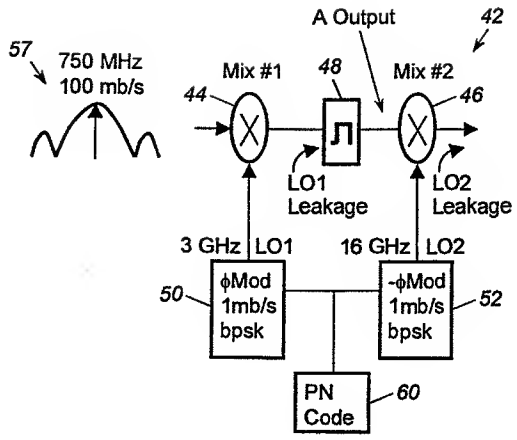


FIG. 3

In accordance with an important aspect of the invention, the local oscillator signal L01 is phase modulated by way of a pseudorandom number code (PN) 60. The output of the first mixer stage is applied as an input to the second mixer stage, for example, by way of a simple IF filter 48, used to filter out leakage from the first local oscillator. The second local oscillator signal is inverse phase modulated by way of the phase modulator 52 using the same PN code. As shown in Figs 4 and 5 and discussed in paragraphs [0019] and [0020] of the specification, the invention recited in independent claims 1 and 28 significantly reduces the power level of various spurs to acceptable levels to obviate the need for relatively narrow band filters.

Grounds of Rejection to be Reviewed on Appeal

I. Whether the rejection of claims 1, 6, 14, 28 and 32 as unpatentable under 35 USC §103 over Thorson US Patent No. 6,101,225 ("the Thorson patent") in view of

Horiguchi et al US Patent No. 6,133,791 ("the Horiguchi et al patent") and further in view of Pitel US Patent No. 4,661,897 ("the Pitel patent") should be reversed.

II. Whether the rejection of Claims 2-5, 12, 29 and 30 under 35 USC §103 as being unpatentable over the Thorson , Horiguchi et al and Pitel patents further in view of Underbrink et al US Patent No. 6, 754,287 ("the Underbrink et al patent) should be reversed.

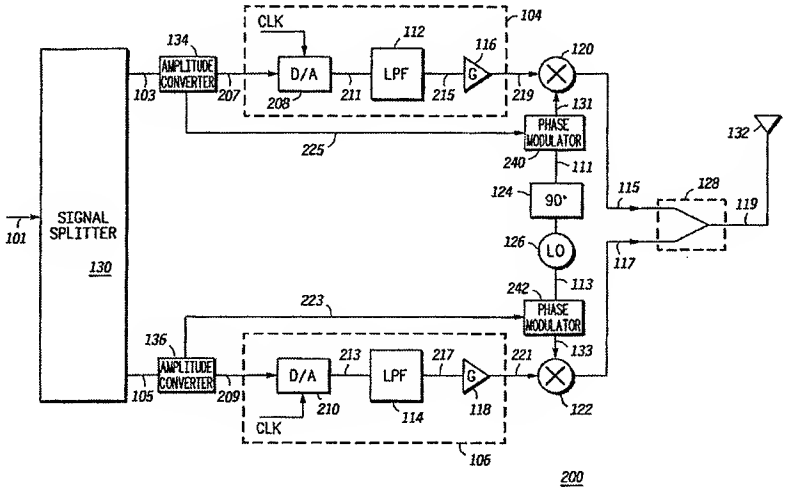
III Whether the rejection of Claims 15 and 31 have been rejected under 35 USC §103 as being unpatentable over the Thorson , Horiguchi et al and Pitel patents further in view of Scott US Patent No. 5,784,403 ("the Scott patent) should be reversed.

Argument

I. The Examiner's rejection of Claims 1, 6, 14, 28 and 32 under 35 USC §103 should be reversed

Claims 1, 6, 14, 28 and 32 have been rejected under 35 USC §103 as being unpatentable over Thorson US Patent No. 6,101,225 ("the Thorson patent") in view of Horiguchi et al US Patent No. 6,133,791 ("the Horiguchi et al patent") and further in view of Pitel US Patent No. 4,661,897 ("the Pitel patent"). It is submitted that none of the cited references , either singly or in combination, disclose or suggest the inventions recited in the claims. It is further submitted that none of the cited references has anything to do with reducing the power level of spurs resulting from mixing signals of different frequencies. It is respectfully submitted that the Examiner is simply combining references in a piecemeal fashion using the claims as a blueprint The invention does not reside in the use of two mixers in a circuit but rather the configuration of two mixers in a manner to reduce the power level of spurs. At best, the references disclose the use of two mixers; however, not configured in a manner recited in the claims at issue. In fact, none of the references are even recognize the problem. Without a recognition of the problem, how can these references be said to suggest the solution to the problem.

Even though the Thorson patent discloses the use of two (2) mixers in one application, the configuration of those mixers is clearly different than the configuration of the mixers recited in the claims at issue. Fig. 2 of the Thorson patent is provided below for the convenience of the Board.



As the Board will kindly note, the system disclosed in the Thorson patent illustrates a pair of mixers 120 and 122. Each mixer 120, 122 is used in a different channel or branch of the circuit. In particular, the incoming input signal 101 is split into an in-phase signal and a quadrature signal. One of mixers 120, 122 is in each of the branches and is used to mix the in-phase and quadrature signals with a phase modulated local oscillator signal . The outputs of the mixers 120, 122 are combined together by way of a combiner 128, unlike the configuration of the inventions recited in the claims at issue in which the output of the first mixer is applied as an input to the second mixer. In this respect, the Thorson patent teaches away from the invention. .

Neither of the other patents cited disclose a circuit with two mixers. In particular, the Horiguchi et al patent was cited for disclosing modulation of a local oscillator signal with a pseudorandom number and mixing that signal with an input signal. The Horiguchi et al patent only discloses a single mixer. The Pitel patent has nothing to do with mixers.

In particular, the Pitel patent was cited for teaching " a second modulator (which) is an inverse modulator (inverter 17 in fig. 7) for modulating a LO signal (the output from oscillator 12 in fig. 7) using the same pseudorandom code as the first modulator (it would be obvious that modulators 17 and 18 use the same received pseudorandom code)."

It is clear that none of cited references disclose or suggest a circuit with two mixers configured as recited in the claims at issue; namely with the output of one mixer feeding the input of the second mixer . This element is clearly missing from all of the references. It is respectfully submitted that the Examiner's rejection is based upon identifying components in the claimed circuit and citing references which disclose those components with no regard to the configuration of the components. If such technique was the law, which it is not, then all electronic circuits, for example, utilizing transistors , resistors , capacitors , etc would be obvious no matter how they were configured and no matter what function the circuit provided. For all of the above reasons, the Board is respectfully requested to reverse the Examiner's rejection of Claims 1, 6, 14, 28 and 32.

II. The Examiner's rejection of Claims 2-5, 12, 29 and 30 under 35 USC §103 should be reversed

Claims 2-5, 12, 29 and 30 have been rejected under 35 USC §103 as being unpatentable over the Thorson , Horiguchi et al and Pitel patents further in view of Underbrink et al US Patent No. 6, 754,287 ("the Underbrink et al patent). It is respectfully submitted that none of the cited references , either singly or in combination, disclose or suggest the inventions recited in the claims. Claims 2-5, 12, 29 and 30 are all dependent claims, dependent on either Claim 1 or Claim 28. The Thorson , Horiguchi et al and Pitel patents have been discussed above. The Underbrink et al patent was cited for disclosing a PSK modular. It does not otherwise disclose a tandem configuration of mixers as recited in claims at issue. For these reasons and the above reasons, the Board is respectfully requested to reverse this rejection.

III. The Examiner's rejection of Claims 2-5, 12, 29 and 30 under 35 USC §103 should be reversed

Claims 15 and 31 have been rejected under 35 USC §103 as being unpatentable over the Thorson , Horiguchi et al and Pitel patents further in view of Scott US Patent No. 5,784,403 ("the Scott patent). It is respectfully submitted that none of the cited references , either singly or in combination, disclose or suggest the inventions recited in the claims. Claims 15 and 31 are dependent claims, dependent on either Claim 1 or Claim 28. The Thorson , Horiguchi et al and Pitel patents have been discussed above. The Scott patent was cited for disclosing a GMSK modular. It does not otherwise disclose a tandem configuration of mixers as recited in claims at issue. For these reasons and the above reasons, the Board is respectfully requested to reverse this rejection.

Conclusion

It is respectfully requested that the Board reverse the rejections of all claims.

Respectfully Submitted,

John S. Paniaguas
Registration No. 31,051

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KATTEN MUCHIN ROSENMAN LLP
2900 K Street, NW
Suite 200
Washington, DC 20007-5118
Phone No. (312) 902-5200
Fax No. (312) 902-1061

APPENDIX A
CLAIMS ON APPEAL

1. A mixer circuit for reducing the power level of spurious output signals, the mixer comprising:

a first mixer stage which includes a first mixer with first and second input ports and ~~an~~ a first output port, said first input port for receiving an input signal and mixing said input signal with a modulated first local oscillator signal to generate a first output signal having a first frequency and spurious output signals at frequencies other than said first frequency;

a second mixer stage which includes a second mixer with third and fourth input ports and a second output port, said first output port of said first mixer electrically coupled to said third input port of said second mixer for mixing said first output signal from said first mixer with a modulated second local oscillator signal and generating a second output signal at a second frequency and spurious output signals at frequencies other than said first frequency and said second frequency;

a phase modulator for phase modulating a first local oscillator signal, modulated by a pseudorandom number defining said modulated first oscillator signal , said phase modulator electrically coupled to said second input port of said first mixer; and

an inverse phase modulator for inverse phase modulating a second local oscillator signal, modulated by the same pseudorandom number defining said modulated second oscillator signal , said inverse phase modulator electrically coupled to said fourth input port of said second mixer to produce an output signal at said second output port with reduced spurious signals

2. The mixer circuit as recited in claim 1, wherein said phase modulator is a phase shift keying (PSK) modulator.

3. The mixer circuit as recited in claim 2, wherein said inverse phase modulator is a phase shift keying (PSK) modulator.

4. The mixer circuit as recited in claim 2, wherein said phase modulator is a first direct sequence binary phase shift keying (BPSK) modulator modulated according to a pseudorandom number (PN) code and said mixer circuit includes a PN code generator for generating said PN code.

5. The mixer circuit as recited in claim 4, wherein said inverse phase modulator is a second direct sequence binary phase shift keying modulator modulated according to said PN code.

6. The mixer circuit as recited in claim 1, further including an intermediate filter coupled between said first output port and one of said third and fourth input ports.

12. The mixer as recited in claim 1, wherein said modulator and said inverse modulator are configured for QPSK modulation.

13. The mixer as recited in claim 1, wherein said modulator and said inverse modulator are configured for PSK modulation.

14. The mixer as recited in claim 1, wherein said modulator and said inverse modulator are configured for M-ary modulation techniques.

15. The mixer as recited in claim 1, wherein said modulator and said inverse modulator are configured for GMSK modulation techniques.

28. (Currently Amended) A method of reducing the power levels of spurious output signals at the output of a mixer circuit comprising the steps of:

(a) providing a two stage mixer including a first mixer and a second mixer, said first mixer and said second mixer each having a local oscillator port, an input port for receiving first and second local oscillator signals and an output port ;

(b) providing a first local oscillator signal and a second local oscillator signal;

(c) phase modulating said first local oscillator signal with a pseudorandom number defining a modulated first oscillator signal and applying said modulated first local oscillator signal to said local oscillator port of said first mixer;

(d) inverse phase modulating said second local oscillator signal defining a modulated second oscillator signal and applying said modulated second local oscillator signal to said local oscillator port of said second mixer with the same pseudorandom number used in step (c) ; and

(e) connecting said output port of said first mixer to said input port of said second mixer.

29. The method as recited in claim 28, wherein modulating and inverse modulating in steps (b) and (c) are accomplished by BPSK modulation techniques.

30. The method as recited in claim 28, wherein modulating and inverse modulating in steps (b) and (c) are accomplished by QPSK modulation techniques.

31. The method as recited in claim 28, wherein modulating and inverse modulating in steps (b) and (c) are accomplished by GMSK modulation techniques.

32. The method as recited in claim 28, wherein modulating and inverse modulating in steps (b) and (c) are accomplished by M-ary modulation techniques.

APPENDIX B
EVIDENCE APPENDIX

None